PERIODIC TABLE OF THE ELEMENTS

Table of Selected Radioactive Isotopes

$_{0}n$	1	(15.3 min) β^-
$_{1}H$	3	(12.26 y) β^-
$_{4}Be$	7	(53.3 d) EC
	10	(1.6 x 10^6 y) β^-
$_{6}C$	11	(20.40 min) β^+
	14	(5730 y) β^-
$_{9}F$	18	(109.8 min) β^+
$_{11}Na$	22	(2.602 y) β^+, EC
	24	(15.02 h) β^-
$_{12}Mg$	28	(20.9 h) β^-
$_{13}Al$	26	(7.2 x 10^5 y) β^+, EC
$_{15}P$	32	(14.26 d) β^-
$_{16}S$	35	(87.2 d) β^-
$_{17}Cl$	36	(3.01 x 10^5 y) β^-
	38	(37.2 min) β^-
$_{18}Ar$	37	(35.02 d) EC
	39	(265 y) β^-
$_{19}K$	40	(1.28 x 10^9 y) EC
	42	(12.36 h) β^-
$_{20}Ca$	45	(165 d) β^-
$_{21}Sc$	46	(83.80 d) β^-
$_{24}Cr$	51	(27.70 d) EC
$_{25}Mn$	53	(2 x 10^6 y) EC
	54	(313.0 d) EC
	56	(2.578 h) β^-
$_{26}Fe$	59	(44.6 d) β^-
$_{27}Co$	56	(78.8d) β^+, EC
	57	(270 d) EC
	58	(71.3 d) β^+, EC
	60	(5.272 y) β^-
$_{28}Ni$	57	(36.0 h) β^+, EC
	59	(8 x 10^4 y) EC
	63	(92 y) β^-
$_{29}Cu$	64	(12.70 h) β^-, β^+, EC
	67	(61.88 h) β^-
$_{30}Zn$	65	(244.1 d) β^+, EC
$_{31}Ga$	67	(78.2 h) EC
	72	(14.10 h) β^-
$_{32}Ge$	68	(275 d) EC
$_{33}As$	73	(80.3 d) EC
	74	(17.9 d) β^-, β^+, EC
$_{34}Se$	75	(118.5 d) β^-
	79	(6.5 x 10^4 y) β^-
$_{35}Br$	82	(35.34 h) β^-
$_{36}Kr$	81	(2.1 x 10^5 y) EC
	85	(10.72 y) β^-
$_{37}Rb$	86	(18.7 d) β^-
	87	(4.8 x 10^{10} y) β^-
$_{38}Sr$	90	(28.8 y) β^-
$_{39}Y$	88	(106.6 d) β^+, EC
$_{40}Zr$	93	(1.5 x 10^6 y) β^-
	95	(64.0 d) β^-
$_{41}Nb$	94	(2.0 x 10^4 y) β^-
	95	(35.15 d) β^-
$_{42}Mo$	99	(66.02 h) β^-
$_{43}Tc$	97	(2.6 x 10^6 y) EC
	98	(4.2 x 10^6 y) β^-
	99	(2.13 x 10^5 y) β^-
$_{44}Ru$	106	(367 d) β^-
$_{45}Rh$	101	(3.3 y) EC
$_{46}Pd$	103	(17.0 d) EC
	107	(7 x 10^6 y) β^-
$_{47}Ag$	108	(127 y) EC
	110	(252 d) β^-
	111	(7.45 d) β^-
$_{48}Cd$	109	(453 d) EC
$_{49}In$	114	(49.51 d) IT
$_{50}Sn$	121	(76 y) β^-
$_{51}Sb$	124	(60.20 d) β^-
	125	(2.7 y) β^-
$_{52}Te$	121 m	(154 d) IT
	123 m	(119.7 d) IT
	127 m	(109 d) IT
$_{53}I$	129	(1.6 x 10^7 y) β^-
	131	(8.040 d) β^-
$_{54}Xe$	133	(5.25 d) β^-
	135	(9.10 h) β^-
$_{55}Cs$	134	(2.06 y) β^-
	135	(2.9 x 10^6 y) β-
	137	(30.17 y) β^-
$_{56}Ba$	140	(12.8 d) β^-
$_{57}La$	137	(6 x 10^4 y) EC
	140	(40.3 h) β^-
$_{58}Ce$	144	(284 d) β^-
$_{59}Pr$	142	(19.1 h) β^-
$_{60}Nd$	147	(11.1 d) β^-
$_{61}Pm$	145	(18 y) EC
	147	(2.62 y) β^-
$_{62}Sm$	146	(7 x 10^7 y) α
	151	(93 y) β^-
$_{63}Eu$	152	(13 y) β^+, EC, β^-
	154	(8.5 y) β^-
$_{64}Gd$	150	(2.1 x 10^6 y) α
$_{65}Tb$	158	(1.2 x 10^5 y) EC, β^-
	160	(72.3 d) β^-
$_{67}Ho$	166 m	(1.2 x 10^3 y) β^-
$_{69}Tm$	170	(128.6 d) β^-
	171	(1.92 y) β^-
$_{70}Yb$	169	(32.0 d) EC
	175	(4.19 d) β^-
$_{71}Lu$	176	(3.7 x 10^{10} y) β^-
$_{73}Ta$	182	(115.0 d) β^-
$_{74}W$	181	(140 d) EC
	185	(75.1 d) β^-
	188	(69 d) β^-
$_{75}Re$	187	(5 x 10^{10} y) β^-
$_{76}Os$	194	(6.0 y) β^-
$_{77}Ir$	192	(74.2 d) β^-, β^+, EC
$_{79}Au$	195	(183 d) EC
	196	(6.18 d) β^+, EC, β^-
	198	(2.696 d) β^-
	199	(3.15 d) β^-
$_{80}Hg$	203	(46.8 d) β^-
$_{81}Tl$	204	(3.77 y) β^-
$_{82}Pb$	202	(3 x 10^5 y) EC
	205	(3 x 10^7 y) EC
	210	(22.3 y) β^-, α
$_{83}Bi$	207	(38 y) EC
	208	(3.7 x 10^5 y) EC
	210	(5.01 d) β^-, α
	210 m	(3 x 10^6 y) α
$_{84}Po$	208	(2.90 y) α
	209	(102 y) α
	210	(138.38 d) α
$_{85}At$	209	(5.4 h) EC, α
	210	(8.1 h) EC
	211	(7.21 h) EC, α
$_{86}Rn$	222	(3.824 d) α
$_{87}Fr$	212	(19.3 min) EC, α
	222	(15 min) β^-
	223	(21.8 min) β^-
$_{88}Ra$	226	(1.60 x 10^3 y) α
$_{89}Ac$	227	(21.77 y) β^-
$_{90}Th$	228	(1.913 y) α
	230	(7.7 x 10^4 y) α
	232	(1.40 x 10^{10} y) α
$_{91}Pa$	231	(3.28 x 10^4 y) α
$_{92}U$	233	(1.59 x 10^5 y) α
	234	(2.44 x 10^5 y) α
	235	(7.04 x 10^8 y) α
	236	(2.34 x 10^7 y) α
	238	(4.47 x 10^9 y) α
$_{93}Np$	236	(1.1 x 10^5 y) EC, β^-
	237	(2.14 x 10^6 y) α
	239	(2.346 d) β^-
$_{94}Pu$	238	(87.75 y) α
	239	(2.41 x 10^4 y) α
	240	(6.54 x 10^3 y) α
	242	(3.8 x 10^5 y) α
	244	(8.3 x 10^7 y) α
$_{95}Am$	241	(432 y) α
	243	(7.37 x 10^3 y) α
$_{96}Cm$	242	(163.2 d) α
	244	(18.12 y) α
	247	(1.55 x 10^7 y) α
	248	(3.5 x 10^5 y) α, SF
$_{97}Bk$	247	(1.4 x 10^3 y) α
$_{98}Cf$	249	(351 y) α
	251	(900 y) α
$_{99}Es$	252	(472 d) α
	253	(20.47 d) α
	254	(276 d) α
$_{100}Fm$	255	(20.1 h) α
	257	(100.5 d) α
$_{101}Md$	258	(55 d) α
$_{102}No$	259	(58 min) α
$_{103}Lr$	260	(3.0 min) α
$_{104}Rf$	261	(65 s) α
$_{105}Db$	262	(40 s) α
$_{106}Sg$	263	(0.9 d) α

Selected Radioactive Isotopes

Naturally occurring radioactive isotopes are designated by a mass number in blue (although some are also manufactured). Letter m indicates an isomer of another isotope of the same mass number. Half-lives follow in parentheses, where s, min, h, d, and y stand respectively for seconds, minutes, hours, days, and years. The table includes mainly the longer-lived radioactive isotopes; many others have been prepared. Isotopes known to be radioactive but with half-lives exceeding 10^{12} y have not been included. Symbols describing the principal mode (or modes) of decay are as follows (these processes are generally accompanied by gamma radiation):

- α alpha particle emission
- β^- beta particle (electron) emission
- β^+ positron emission
- EC orbital electron capture
- IT isomeric transition from upper to lower isomeric state
- SF spontaneous fission

GROUP 1/IA	2/IIA	3/IIIA	4/IVA	5/VA	6/VIA	7/VIIA	8	9 VIIIA	10	11/IB	12/IIB	13/IIIB	14/IVB	15/VB	16/VIB	17/VIIB	18/VIII
1 1.00794 1,-1 20.28 13.81 0.0899† H $1s^1$ Hydrogen	4 9.012182 2 2744 1560 1.85 Be $[He]2s^2$ Beryllium											5 10.811 3 4275 2348 2.37 B $[He]2s^22p^1$ Boron	6 12.0107 ±4,2 4675* 3915* 2.26 C $[He]2s^22p^2$ Carbon	7 14.0067 ±3,5,4,2 77.344 63.15 1.251† N $[He]2s^22p^3$ Nitrogen	8 15.9994 -2,-1 90.2 54.4 1.429† O $[He]2s^22p^4$ Oxygen	9 18.99840 -1 85.0 53.55 1.696† F $[He]2s^22p^5$ Fluorine	2 4.00260 4.216 0.95 at 26 atm 0.1785† He $1s^2$ Helium
3 (6.941) 1 1615 453.7 0.534 Li $[He]2s^1$ Lithium																	10 20.1797 27.07 24.56 0.900† Ne $[He]2s^22p^6$ Neon
11 22.989770 1 1156.1 371.0 0.971 Na $[Ne]3s^1$ Sodium	12 24.3050 2 1363 923 1.74 Mg $[Ne]3s^2$ Magnesium											13 26.981538 3 2792 933.5 2.6989 Al $[Ne]3s^23p^1$ Aluminum	14 28.0855 4,2 3538 1687 2.33 Si $[Ne]3s^23p^2$ Silicon	15 30.97376 ±3,5,4 553 317.3 1.82 P $[Ne]3s^23p^3$ Phosphorus	16 32.065 6,±2,4, 717.75 388.36 2.07 S $[Ne]3s^23p^4$ Sulfur	17 35.453 ±1,7,5,3 239.11 171.65 3.214† Cl $[Ne]3s^23p^5$ Chlorine	18 39.948 87.8 83.8 1.784† Ar $[Ne]3s^23p^6$ Argon
19 39.0983 1 1033 336.8 0.862 K $[Ar]4s^1$ Potassium	20 40.078 2 1757 1115 1.55 Ca $[Ar]4s^2$ Calcium	21 44.95591 3 3109 1814 2.99 Sc $[Ar]3d^14s^2$ Scandium	22 47.867 4,3,2 3560 1941 4.54 Ti $[Ar]3d^24s^2$ Titanium	23 50.9415 5,4,3,2 3680 2183 6.11 V $[Ar]3d^34s^2$ Vanadium	24 51.996 3,6,2 2945 2180 7.19 Cr $[Ar]3d^54s^1$ Chromium	25 54.9380 2,3,4,6,7 2234 1519 7.44 Mn $[Ar]3d^54s^2$ Manganese	26 55.845 3,2,6 3134 1811 7.874 Fe $[Ar]3d^64s^2$ Iron	27 58.9332 2,3 3200 1768 8.90 Co $[Ar]3d^74s^2$ Cobalt	28 58.6934 2,3 3186 1728 8.90 Ni $[Ar]3d^84s^2$ Nickel	29 63.546 2,1 2835 1357.8 8.96 Cu $[Ar]3d^{10}4s^1$ Copper	30 65.409 2 1180 692.68 7.13 Zn $[Ar]3d^{10}4s^2$ Zinc	31 69.723 1,3 2477 302.91 6.095 Ga $[Ar]3d^{10}4s^24p^1$ Gallium	32 72.64 4 3106 1211.4 5.32 Ge $[Ar]3d^{10}4s^24p^2$ Germanium	33 74.9216 ±3,5 876 (subl.) 1090 (28 atm) 5.73 As $[Ar]3d^{10}4s^24p^3$ Arsenic	34 78.96 4,6,-2 958 494 4.79 Se $[Ar]3d^{10}4s^24p^4$ Selenium	35 79.904 ±1,7,5,3 331.95 265.95 3.12 Br $[Ar]3d^{10}4s^24p^5$ Bromine	36 83.80 0,2 119.93 115.8 3.73† Kr $[Ar]3d^{10}4s^24p^6$ Krypton
37 85.4678 1 961 312.46 1.532 Rb $[Kr]5s^1$ Rubidium	38 87.62 2 1655 1050 2.54 Sr $[Kr]5s^2$ Strontium	39 88.9059 3 3618 1795 4.47 Y $[Kr]4d^15s^2$ Yttrium	40 91.224 4 4682 2128 6.51 Zr $[Kr]4d^25s^2$ Zirconium	41 92.90638 5,3,4 5017 2730 8.57 Nb $[Kr]4d^45s^1$ Niobium	42 95.94 6,5,4,3,2 4912 2896 10.22 Mo $[Kr]4d^55s^1$ Molybdenum	43 (98) 7,5,4 4538 2430 11.5* Tc $[Kr]4d^55s^2$ Technetium	44 101.07 2,3,4,6,8 4423 2607 12.37 Ru $[Kr]4d^75s^1$ Ruthenium	45 102.90550 2,3,4 3968 2237 12.41 Rh $[Kr]4d^85s^1$ Rhodium	46 106.42 2,4 3236 1828 12.0 Pd $[Kr]4d^{10}$ Palladium	47 107.8682 1 2435 1234.93 10.50 Ag $[Kr]4d^{10}5s^1$ Silver	48 112.41 2 1040 594.22 8.65 Cd $[Kr]4d^{10}5s^2$ Cadmium	49 114.82 3 2345 429.75 7.31 In $[Kr]4d^{10}5s^25p^1$ Indium	50 118.710 4,2 2875 505.08 7.31 Sn $[Kr]4d^{10}5s^25p^2$ Tin	51 121.760 ±3,5 1860 903.78 6.69 Sb $[Kr]4d^{10}5s^25p^3$ Antimony	52 127.60 4,6,-2 1261 722.66 6.24 Te $[Kr]4d^{10}5s^25p^4$ Tellurium	53 126.90447 ±1,5,7 457.51 386.85 4.93 I $[Kr]4d^{10}5s^25p^5$ Iodine	54 131.29 0,2,4,6,8 165.11 161.4 5.90† Xe $[Kr]4d^{10}5s^25p^6$ Xenon
55 132.90545 1 944 301.54 1.87 Cs $[Xe]6s^1$ Cesium	56 137.327 2 2170 1000 3.5 Ba $[Xe]6s^2$ Barium	57 138.9055 3 ★ 3737 1191 6.15 La $[Xe]5d^16s^2$ Lanthanum	72 178.49 4 4876 2506 13.31 Hf $[Xe]4f^{14}5d^26s^2$ Hafnium	73 180.9479 5,4 5730 3290 16.65 Ta $[Xe]4f^{14}5d^36s^2$ Tantalum	74 183.84 6,5,4,3,2 5828 3695 19.3 W $[Xe]4f^{14}5d^46s^2$ Tungsten	75 186.207 7,6,5,4,3,2 5870 3459 21.0 Re $[Xe]4f^{14}5d^56s^2$ Rhenium	76 190.23 4,8,6,3,2 5285 3306 22.57 Os $[Xe]4f^{14}5d^66s^2$ Osmium	77 192.217 4,2,6,3 4700 2720 22.42 Ir $[Xe]4f^{14}5d^76s^2$ Iridium	78 195.08 4,2 4098 2041.55 21.45 Pt $[Xe]4f^{14}5d^96s^1$ Platinum	79 196.96655 3,1 3130 1337.33 19.3 Au $[Xe]4f^{14}5d^{10}6s^1$ Gold	80 200.59 2,1 629.88 234.32 13.55 Hg $[Xe]4f^{14}5d^{10}6s^2$ Mercury	81 204.3833 3,1 1746 577 11.85 Tl $[Xe]4f^{14}5d^{10}6s^26p^1$ Thallium	82 207.2 2,4 2022 600.61 11.35 Pb $[Xe]4f^{14}5d^{10}6s^26p^2$ Lead	83 208.9804 3,5 1837 544.55 9.75 Bi $[Xe]4f^{14}5d^{10}6s^26p^3$ Bismuth	84 (209) 4,2,6 — 527 9.3 Po $[Xe]4f^{14}5d^{10}6s^26p^4$ Polonium	85 (210) ±1,7,5,3 610* 575 — At $[Xe]4f^{14}5d^{10}6s^26p^5$ Astatine	86 (222) 0,2 211.4 202 9.73† Rn $[Xe]4f^{14}5d^{10}6s^26p^6$ Radon
87 (223) 1 950* 300 — Fr $[Rn]7s^1$ Francium	88 (226) 2 1413 973 5.0 Ra $[Rn]7s^2$ Radium	89 (227) 3 ★★ 3470* 1324 10.07 Ac $[Rn]6d^17s^2$ Actinium	104 (261) — — — Rf $[Rn]5f^{14}6d^27s^2$ Rutherfordium	105 (262) — — — Db $[Rn]5f^{14}6d^37s^2$ Dubnium	106 (266) — — — Sg $[Rn]5f^{14}6d^47s^2$ Seaborgium	107 (264) — — — Bh $[Rn]5f^{14}6d^57s^2$ Bohrium	108 (277) — — — Hs $[Rn]5f^{14}6d^67s^2$ Hassium	109 (268) — — — Mt $[Rn]5f^{14}6d^77s^2$ Meitnerium	110 (269) — — — Ds $[Rn]5f^{14}6d^97s^2$ (Darmstadtium)	111 (272) — — — Rg $[Rn]5f^{14}6d^97s^2$ (Roentgenium)	112 (285) — — — Uub $[Rn]5f^{14}6d^{10}7s^2$ (Ununbium)	113 (284) — — — Uut $[Rn]5f^{14}6d^{10}7s^27p^1$ (Ununtrium)	114 (289) — — — Uuq $[Rn]5f^{14}6d^{10}7s^27p^2$ (Ununquadium)	115 (288) — — — Uup $[Rn]5f^{14}6d^{10}7s^27p^3$ (Ununpentium)	116 — — — Uuh $[Rn]5f^{14}6d^{10}7s^27p^4$ (Ununhexium)	117 — — — Uus (Ununseptium)	118 — — — Uuo (Ununoctium)

* Estimated Values

★ 58 140.116 3,4 3716 1071 6.77 Ce $[Xe]4f^15d^16s^2$ Cerium	59 140.90765 3,4 3785 1204 6.77 Pr $[Xe]4f^36s^2$ Praseodymium	60 144.24 3 3347 1294 7.01 Nd $[Xe]4f^46s^2$ Neodymium	61 (145) 3 3273 1315 7.26 Pm $[Xe]4f^56s^2$ Promethium	62 150.36 3,2 2067 1347 7.52 Sm $[Xe]4f^66s^2$ Samarium	63 151.964 3,2 1869 1095 5.24 Eu $[Xe]4f^76s^2$ Europium	64 157.25 3 3546 1586 7.90 Gd $[Xe]4f^75d^16s^2$ Gadolinium	65 158.92534 3,4 3503 1629 8.23 Tb $[Xe]4f^96s^2$ Terbium	66 162.50 3 2840 1685 8.55 Dy $[Xe]4f^{10}6s^2$ Dysprosium	67 164.9303 3 2973 1747 8.795 Ho $[Xe]4f^{11}6s^2$ Holmium	68 167.26 3 3140 1802 9.07 Er $[Xe]4f^{12}6s^2$ Erbium	69 168.9342 3,2 2223 1818 9.32 Tm $[Xe]4f^{13}6s^2$ Thulium	70 173.04 3,2 1469 1092 6.903 Yb $[Xe]4f^{14}6s^2$ Ytterbium	71 174.967 3 3675 1936 9.841 Lu $[Xe]4f^{14}5d^16s^2$ Lutetium
★★ 90 232.0381 4 5061 2023 11.72 Th $[Rn]6d^27s^2$ Thorium	91 231.0359 5,4 4300* 1845 15.4* Pa $[Rn]5f^26d^17s^2$ Protactinium	92 238.0289 6,5,4,3,2 4404 1408 18.95 U $[Rn]5f^36d^17s^2$ Uranium	93 (237) 5,6,4,3 4175* 917 20.2 Np $[Rn]5f^46d^17s^2$ Neptunium	94 (244) 4,6,5,3 3505 913 19.84 Pu $[Rn]5f^67s^2$ Plutonium	95 (243) 3,6,5,4,2 2284 1449 13.7 Am $[Rn]5f^77s^2$ Americium	96 (247) 3 — 1620 13.5* Cm $[Rn]5f^76d^17s^2$ Curium	97 (247) 2,3,4 — — 14* Bk $[Rn]5f^97s^2$ Berkelium	98 (251) 2,3,4 — 1170* — Cf $[Rn]5f^{10}7s^2$ Californium	99 (252) 3 — 1130* — Es $[Rn]5f^{11}7s^2$ Einsteinium	100 (257) 3 — 1800* — Fm $[Rn]5f^{12}7s^2$ Fermium	101 (258) 3 — 1100* — Md $[Rn]5f^{13}7s^2$ Mendelevium	102 (259) 2,3 — 1100* — No $[Rn]5f^{14}7s^2$ Nobelium	103 (262) 3 — 1900* — Lr $[Rn]5f^{14}6d^17s^2$ Lawrencium

KEY

- ATOMIC NUMBER: 30
- ATOMIC WEIGHT (2): 65.409
- BOILING POINT, K: 1180
- MELTING POINT, K: 692.73
- SYMBOL: Zn
- OXIDATION STATES (Bold most stable): 2
- ELECTRON CONFIGURATION: $[Ar]3d^{10}4s^2$
- NAME: Zinc
- DENSITY AT 300 K (3) (g/cm³): 7.13

NOTES:

(1) Black — solid.
Red — gas.
Blue — liquid.
Outline — synthetically prepared.

(2) Based upon carbon-12. ( ) indicates most stable or best known isotope.

(3) Entries marked with daggers refer to the gaseous state at 273 K and 1 atm and are given in units of g/l.

The A & B subgroup designations, are those recommended by the International Union of Pure and Applied Chemistry.

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Side 1

TABLE OF PERIODIC PROPERTIES OF THE ELEMENTS

Percent Ionic Character of a Single Chemical Bond

Difference in electronegativity	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2
Percent ionic character %	0.5	1	2	4	6	9	12	15	19	22	26	30	34	39	43	47	51	55	59	63	67	70	74	76	79	82	84	86	88	89	91	92

DATA CONCERNING THE MORE STABLE ELEMENTARY (SUBATOMIC) PARTICLES

	Neutron	Proton	Electron*	Neutrino*	Photon
Symbol	n	P	e (e-)	ν	γ
Rest mass (kg)	1.67495×10^{-27}	1.67265×10^{-27}	9.1095×10^{-31}	~0	0
Relative atomic mass (^{12}C=12)	1.008665	1.007276	5.48580×10^{-4}	~0	0
Charge (C)	0	1.60219×10^{-19}	-1.60219×10^{-19}	0	0
Radius (m)	8×10^{-16}	8×10^{-16}	$<1\times10^{-16}$	~0	0
Spin quantum number	1/2	1/2	1/2	1/2	1
Magnetic Moment†	$-1.913\ \mu_N$	$2.793\ \mu_N$	$1.001\ \mu_B$	0	0

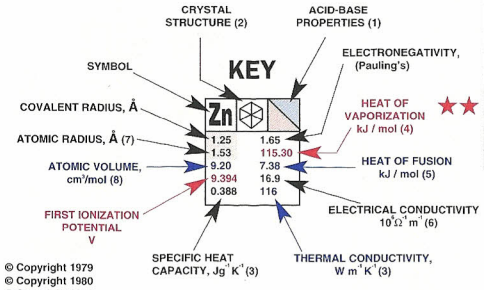
* The positron (e+) has properties similar to those of the (negative) electron or beta particle except that its charge has opposite sign (+). The antineutrino ($\bar{\nu}$) has properties similar to those of the neutrino except that its spin (or rotation) is opposite in relation to its direction of propagation.

An antineutrino accompanies release of an electron in radioactive β (particle) decay, whereas a neutrino accompanies the release of a positron in β^+ decay.

†μ_B=Bohr magneton and μ_N=Nuclear magneton.

Symbol	Atomic number	Atomic mass	Density	Melting point	Boiling point	Specific heat	Electronegativity	Covalent radius	Atomic radius	Atomic volume	First ionization potential	Heat of vaporization	Heat of fusion	Electrical conductivity	Thermal conductivity	Crystal structure	Acid-base properties
H	1	1.008	0.0899	14.01	20.28	14.304	2.20	0.32	0.79	14.10	13.598	0.0585	0.0585	—	0.1815		
He	2	4.003	0.1785	—	4.216	5.193	—	0.93	—	31.80	24.587	0.021	0.084	—	0.152		
Li	3	6.941	0.534	453.7	1615	3.582	0.98	1.23	2.05	13.10	5.392	11.7	147.1	3.0	84.7		
Be	4	9.012182	1.848	1560	2742	1.825	1.57	0.90	1.40	5.0	9.323	25	297	11.71	200		
B	5	10.811	2.34	2349	4200	1.026	2.04	0.82	1.17	4.6	8.298	5×10^{-12}	507.8	22.6	27.0		
C	6	12.0107	2.267	3823	4300	0.709	2.55	0.77	0.91	5.30	11.260	0.07	715	—	80-230		
N	7	14.00674	0.1251	63.15	77.35	1.042	3.04	0.75	0.75	17.30	14.534	—	2.793	0.36	0.02598		
O	8	15.9994	0.1429	54.8	90.19	0.918	3.44	0.73	0.65	14.0	13.618	—	3.410	0.222	0.2674		
F	9	18.9984032	0.1696	53.53	85.03	0.824	3.98	0.72	0.57	17.10	17.422	—	3.27	0.26	0.0279		
Ne	10	20.1797	0.9002	24.56	27.07	1.030	—	0.71	0.51	16.90	21.564	—	1.77	0.34	0.0493		
Na	11	22.989770	0.971	370.87	1156.1	1.228	0.93	1.54	2.23	23.70	5.139	20.1	98.01	2.601	141		
Mg	12	24.3050	1.738	923	1363	1.02	1.31	1.36	1.72	14.0	7.646	22.4	127.6	8.95	156		
Al	13	26.981539	2.7	933.47	2792	0.900	1.61	1.18	1.82	10.0	5.986	37.7	290.8	10.7	237		
Si	14	28.0855	2.3290	1687	3538	0.705	1.90	1.11	1.46	12.1	8.152	4×10^{-4}	50.2	148.	148.		
P	15	30.973761	1.823	317.30	553	0.769	2.19	1.06	1.23	17.0	10.487	10^{-16}	12.4	0.63	0.235		
S	16	32.066	2.07	388.36	717.824	0.710	2.58	1.02	1.09	15.50	10.360	5×10^{-16}	10	1.73	0.269		
Cl	17	35.4527	3.214	172.17	239.18	0.479	3.16	0.99	0.97	18.70	12.967	—	10.20	3.21	0.0089		
Ar	18	39.948	1.7837	83.81	87.29	0.520	—	0.98	0.88	24.20	15.759	—	6.506	1.188	0.0177		
K	19	39.0983	0.862	336.8	1047	0.757	0.82	2.03	2.77	45.30	4.341	16.4	76.9	2.33	102.5		
Ca	20	40.078	1.55	1115	1757	0.647	1.00	1.74	2.23	29.90	6.113	31.3	154.67	8.53	200		
Sc	21	44.955912	2.989	1812	3109	0.568	1.36	1.44	2.09	15.0	6.56	1.5	304.80	16.11	15.8		
Ti	22	47.867	4.54	1933	3560	0.523	1.54	1.32	2.00	10.60	6.83	2.6	425.2	18.6	21.9		
V	23	50.9415	6.11	2183	3680	0.489	1.63	1.22	1.92	8.35	6.75	4.0	446.7	22.8	30.7		
Cr	24	51.9961	7.19	2180	2944	0.449	1.66	1.18	1.85	7.23	6.766	7.9	339.5	20	93.7		
Mn	25	54.938049	7.3	1246	2235	0.479	1.55	1.17	1.79	7.39	7.434	0.5	219.74	14.64	7.82		
Fe	26	55.845	7.87	1808	3023	0.449	1.83	1.17	1.72	7.1	7.902	11.2	349.5	13.8	80.2		
Co	27	58.933200	8.9	1768	3143	0.421	1.88	1.16	1.67	6.70	7.88	17.9	373.3	16.2	100		
Ni	28	58.6934	8.9	1728	3186	0.444	1.91	1.15	1.62	6.60	7.640	14.6	377.5	17.2	90.7		
Cu	29	63.546	8.96	1357.77	2835	0.385	1.90	1.17	1.57	7.1	7.726	60.7	300.5	13.14	401		
Zn	30	65.409	7.133	692.73	1180	0.388	1.65	1.25	1.53	9.2	9.394	16.9	115.31	31.80	116		
Ga	31	69.723	5.91	302.9146	2403	0.371	1.81	1.26	1.81	11.8	5.999	1.8	256.06	5.59	40.6		
Ge	32	72.64	5.323	1211.40	3106	0.320	2.01	1.22	1.52	13.6	7.899	3×10^{-8}	334.30	31.80	59.9		
As	33	74.92160	5.73	1090	887	0.329	2.18	1.20	1.33	13.1	9.79	3.8	32.4	27.7	50		
Se	34	78.96	4.81	494	958	0.321	2.55	1.16	1.22	16.50	9.752	8	26.32	5.44	2.04		
Br	35	79.904	3.12	265.8	332.0	0.226	2.96	1.14	1.12	23.5	11.814	10^{-16}	14.725	5.285	0.122		
Kr	36	83.798	3.749	115.79	119.93	0.248	1.89	1.89	1.03	32.20	13.999	—	9.03	1.64	0.00949		
Rb	37	85.4678	1.532	312.46	961	0.363	0.82	2.16	2.98	55.9	4.177	47.8	69.2	2.34	58.2		
Sr	38	87.62	2.54	1050	1384	0.301	0.95	1.91	2.45	33.7	5.695	5.0	136.9	8.2	35.3		
Y	39	88.90585	4.469	1526	3336	0.30	1.22	1.62	2.27	19.8	6.22	1.8	393.30	17.15	17.2		
Zr	40	91.224	6.506	2128	4682	0.278	1.33	1.45	2.16	14.1	6.63	2.3	590.5	21	22.7		
Nb	41	92.90638	8.57	2741	5015	0.265	1.6	1.34	2.08	10.80	6.76	6.6	690.1	26.9	53.7		
Mo	42	95.94	10.22	2896	4912	0.251	2.16	1.30	2.01	9.4	7.092	17.3	590.4	36	138		
Tc	43	[98]	11.5	2430	4538	0.24	1.9	1.27	1.95	8.5	7.28	0.001	502	23	50.6		
Ru	44	101.07	12.41	2607	4423	0.238	2.2	1.25	1.89	8.3	7.36	14.9	567.77	25.52	117		
Rh	45	102.90550	12.41	2237	4912	0.243	2.28	1.25	1.83	8.30	7.46	23	495.39	21.76	150		
Pd	46	106.42	12.02	1828.05	3236	0.244	2.20	1.28	1.79	8.9	8.34	10.0	393.3	16.74	71.8		
Ag	47	107.8682	10.501	1234.93	2436	0.235	1.93	1.34	1.75	10.3	7.576	62.9	250.63	11.3	429		
Cd	48	112.411	8.65	594.22	1040	0.232	1.69	1.41	1.71	13.1	8.993	14.7	99.87	6.07	96.8		
In	49	114.818	7.31	429.75	2345	0.233	1.78	1.44	2.00	15.7	5.786	3.4	226.35	3.26	81.6		
Sn	50	118.710	7.287	505.08	2875	0.228	1.96	1.41	1.72	16.3	7.344	8.7	290.37	7.2	66.6		
Sb	51	121.760	6.685	903.78	1908	0.207	2.05	1.40	1.53	18.40	8.608	2.6	67.97	19.83	24.3		
Te	52	127.60	6.24	723.65	1390	0.202	2.1	1.36	1.42	20.5	9.009	2×10^{-4}	50.63	17.49	2.35		
I	53	126.90447	4.93	386.85	457.4	0.145	2.66	1.33	1.32	25.70	10.451	10^{-11}	20.9	7.76	0.449		
Xe	54	131.293	5.894	161.4	165.051	0.158	2.6	1.31	1.24	42.90	12.130	—	12.64	2.30	0.00569		
Cs	55	132.905452	1.873	301.59	944	0.242	0.79	2.35	3.34	70	3.894	5.3	67.740	2.09	35.9		
Ba	56	137.327	3.594	1000	2170	0.204	0.89	1.98	2.78	39.0	5.212	2.8	140.2	8.01	18.4		
La	57	138.9055	6.145	1193	3457	0.195	1.10	1.25	2.74	22.50	5.58	1.9	399.57	11.30	13.5		
Hf	72	178.49	13.31	2506	4602	0.144	1.3	1.44	2.16	13.60	6.825	3.4	661.07	21.76	23.0		
Ta	73	180.9479	16.654	3269	5458	0.140	1.5	1.34	2.09	10.90	7.55	8.1	737.0	36	57.5		
W	74	183.84	19.3	3695	5555	0.132	2.36	1.30	2.02	9.53	7.864	18.2	422.58	35.4	174		
Re	75	186.207	21.02	3459	5869	0.137	1.9	1.28	1.97	8.85	7.833	5.8	707.10	33.05	47.9		
Os	76	190.23	22.57	3033	5012	0.130	2.2	1.26	1.92	8.43	8.438	12.3	627.6	29.29	87.6		
Ir	77	192.217	22.42	2446	4428	0.131	2.20	1.27	1.87	8.54	8.967	21.3	563.58	26.36	147		
Pt	78	195.078	21.45	1768.3	4098	0.133	2.28	1.30	1.83	9.10	8.959	9.4	510.45	19.66	71.6		
Au	79	196.96655	19.32	1337.33	3129	0.129	2.54	1.34	1.79	10.20	9.225	48.8	324.43	12.36	317		
Hg	80	200.592	13.546	234.32	629.88	0.140	2.00	1.49	1.76	14.80	10.437	1.0	59.30	2.292	8.34		
Tl	81	204.3833	11.85	577	1473	0.129	2.04	1.48	2.08	17.20	6.108	5.6	162.09	4.27	46.1		
Pb	82	207.2	11.34	600.61	2022	0.129	2.33	1.47	1.81	18.30	7.416	4.8	177.9	4.77	35.3		
Bi	83	208.98038	9.78	544.4	1837	0.122	2.02	1.46	1.63	21.30	7.289	0.9	179	11.0	7.87		
Po	84	[209]	9.32	527	1235	—	2.0	1.53	1.53	22.70	8.41	0.7	120	13	20		
At	85	[210]	—	575	610	—	2.2	1.47	1.43	—	—	—	30	12*	1.7		
Rn	86	[222]	9.73	202	211.4	0.094	2.2	—	1.34	50.5	10.748	—	16.4	2.9	0.00364		
Fr	87	[223]	—	300	950	—	0.7	—	2.7	—	4.073	—	64*	2.1*	15		
Ra	88	[226]	5.0	973	1413	0.094	0.9	—	2.8	45.2	5.278	1.0	136.82	8.37	18.6		
Ac	89	[227]	10.07	1323	3471	0.120	1.1	—	—	22.5	5.17	—	—	—	12		
Rf	104	[261]	—	—	—	—	—	—	—	—	—	—	—	—	—		
Db	105	[262]	—	—	—	—	—	—	—	—	—	—	—	—	—		
Sg	106	[263]	—	—	—	—	—	—	—	—	—	—	—	—	—		
Bh	107	[264]	—	—	—	—	—	—	—	—	—	—	—	—	—		
Hs	108	[265]	—	—	—	—	—	—	—	—	—	—	—	—	—		
Mt	109	[268]	—	—	—	—	—	—	—	—	—	—	—	—	—		
Ds	110	[271]	—	—	—	—	—	—	—	—	—	—	—	—	—		
Rg	111	[272]	—	—	—	—	—	—	—	—	—	—	—	—	—		
Uub	112	[277]	—	—	—	—	—	—	—	—	—	—	—	—	—		
Uut	113	[284]	—	—	—	—	—	—	—	—	—	—	—	—	—		
Uuq	114	[289]	—	—	—	—	—	—	—	—	—	—	—	—	—		
Uup	115	[288]	—	—	—	—	—	—	—	—	—	—	—	—	—		
Uuh	116	[292]	—	—	—	—	—	—	—	—	—	—	—	—	—		
Uus	117	[294]	—	—	—	—	—	—	—	—	—	—	—	—	—		
Uuo	118	[294]	—	—	—	—	—	—	—	—	—	—	—	—	—		
Ce	58	140.116	6.689	1068	3716	0.192	1.12	1.65	2.70	21.0	5.538	1.4	313.80	9.20	11.4		
Pr	59	140.907653	6.773	1208	3793	0.193	1.13	1.65	2.67	20.80	5.473	1.5	332.63	10.04	12.5		
Nd	60	144.24	6.9	1297	3347	0.190	1.14	1.64	2.64	20.6	5.525	1.6	283.68	10.88	16.5		
Pm	61	[145]	7.26	1315	3273	—	1.13	1.63	2.62	22.4	5.582	2	—	—	17.9*		
Sm	62	150.36	7.52	1345	2067	0.197	1.17	1.62	2.59	19.90	5.644	1.1	191.63	11.09	13.3		
Eu	63	151.964	5.243	1099	1802	0.182	1.2	1.85	2.56	28.9	5.67	1.1	175.73	10.46	13.9		
Gd	64	157.25	7.901	1585	3266	0.236	1.20	1.61	2.54	19.90	6.15	0.8	311.71	15.48	10.6		
Tb	65	158.92534	8.229	1629	3123	0.182	1.1	1.59	2.51	19.20	5.864	0.9	—	—	11.1		
DY	66	162.500	8.551	1680	2567	0.173	1.22	1.59	2.49	19.0	5.939	1.1	230	11.06	10.7		
Ho	67	164.93032	8.795	1734	2700	0.165	1.23	1.58	2.47	18.70	6.021	1.1	251.04	17.15	16.2		
Er	68	167.259	9.066	1802	3136	0.168	1.24	1.57	2.45	18.40	6.108	1.2	292.88	17.15	14.3		
Tm	69	168.93421	9.321	1818	2223	0.160	1.25	1.56	2.42	18.10	6.184	1.3	191*	16.8*	16.8		
Yb	70	173.054	6.966	1097	1469	0.155	1.1	1.70	2.40	24.80	6.254	3.7	128*	7.7*	34.9		
Lu	71	174.9668	9.841	1936	3668	0.154	1.27	1.56	2.25	17.80	5.426	1.5	355*	18.6*	16.4		
Th	90	232.038060	11.72	2023	5061	0.113	1.3	1.65	—	19.90	6.31	7.1	543.92	15.65	54		
Pa	91	231.03588	15.37	1841	4300	—	1.5	—	—	15.0	5.89	5.6	—	—	47		
U	92	238.02891	18.95	1405.3	4404	0.12	1.38	1.42	—	12.50	6.194	3.6	422.58	15.48	27.6		
Np	93	[237]	20.45	917	4273	—	1.36	—	—	21.10	6.266	0.8	—	—	6.3		
Pu	94	[244]	19.84	912.5	3505	0.13*	1.28	1.08	—	12.32	6.026	0.7	6.74	—	10*		
Am	95	[243]	13.67	1449	2880	—	—	—	—	20.8	5.974	0.7	—	—	10*		
Cm	96	[247]	13.51	1340	3110	—	1.3*	—	—	18.3	5.991	—	—	—	10*		
Bk	97	[247]	14.78	1050	2627	—	1.3*	—	—	—	6.198	—	—	—	10*		
Cf	98	[251]	15.1	900	1173	—	1.3*	—	—	—	6.282	—	—	—	10*		
Es	99	[252]	—	860	1133	—	1.3*	—	—	—	6.42	—	—	—	10*		
Fm	100	[257]	—	1527	—	—	1.3*	—	—	—	6.5	—	—	—	10*		
Md	101	[258]	—	1800	—	—	1.3*	—	—	—	6.58	—	—	—	10*		
No	102	[259]	—	827	—	—	1.3*	—	—	—	6.65	—	—	—	10*		
Lr	103	[262]	—	1627	—	—	1.3*	—	—	—	4.9*	—	—	—	10*		

*ESTIMATED VALUES



NOTES: (1) For representative oxides (higher valence) of group. Oxide is acidic if color is red, basic if color is blue and amphoteric if both colors are shown. Intensity of color indicates relative strength.

(2) Cubic, face centered; cubic, body centered; cubic; hexagonal; rhombohedral; tetragonal; orthorhombic; monoclinic.

(3) At 300 K (27°C)
(4) At boiling point
(5) At melting point
(6) Generally at 293 K (20°C) for polycrystalline material
(7) Quantum mechanical value for free atom
(8) From density at 300 K (27°C) for liquid and solid elements; values for gaseous elements refer to liquid state at boiling point

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